Non-intrusive, Distributed Gas Sensing Technology for Advanced Spacesuits

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Chemical sensors for monitoring gas composition, including oxygen, humidity, carbon dioxide, and trace contaminants are needed to characterize and validate spacesuit design and operating parameters. This paper reports on the first prototypes of a non-intrusive gas sensing technology based on flexible sensitive patches positioned inside spacesuit prototypes and interrogated by optical fibers routed outside the suit, taking advantage of the transparent materials of the suit prototypes. The sensitive patches are based on luminescent materials whose emission parameters vary with the partial pressure of a specific gas. Patches sensitive to carbon dioxide, humidity, oxygen, and ammonia have been developed, and their preliminary characterization in the laboratory using Mark III-like helmet parts is described. The first prototype system consists of a four-channel fiber optic luminescent detector that can be used to monitor any of the selected target gases at four locations. To switch from one gas to another we replace the (disposable) sensor patches and adjust the system settings. Repeatability among sensitive patches and of sensor performance from location to location has been confirmed, assuring that suit engineers will have flexibility in selecting multiple sensing points, fitting the sensor elements into the spacesuit, and easily repositioning the sensor elements as desired. The evaluation of the first prototype for monitoring carbon dioxide during washout studies in a space suit prototype is presented.

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